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AN EVALUATION OF SPECIAL GRANT RESEARCH ON SOUTHERN CORN LEAF BLIGHT - CSRS

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INTRODUCTION

Departments and agencies of government are funded to carry out specified operations and functions judged to be in the public interest. The effectiveness and efficiency with which such missions are discharged are a legitimate concern of the public and their selected and appointed representatives. The President's Office of Management and Budget has directed that Federal departments and agencies provide for continuing systematic review of all aspects of program management, including the evaluation of program effectiveness in accomplishing program objectives.

The Department of Agriculture meets this requirement through its Office of Management and Finance to assure that such evaluation is carried out in guidelines to the agencies. This activity has been defined as the ex post facto evaluation of the effectiveness of ongoing programs in meeting the goals of USDA missions, achieving program objectives, and in serving specified target groups. The purpose of this report is to evaluate a defineable segment of ongoing research in the State Agricultural Experiment Stations: research on the Southern Corn Leaf Blight (SCLB) disease of corn.

The Cooperative State Research Service, through Public Law 89-106, is empowered to make grants to various research groups in the U.S. on specific areas of research. The authority exists through the Secretary of Agriculture, who has historically identified CSRS as the authorized agency to make grants through his Office. The Act states: "The Secretary of Agriculture is authorized to make grants for periods not to exceed five years' duration, to State Agricultural Experiment Stations, Colleges, Universities, and other research institutions and organizations, and to federal and private organizations and individuals for Research to further the programs of the Department of Agriculture." 1/

Through the early years of American agriculture, corn production was based upon use of open-pollinated varieties, resulting from farmer and commercial selection programs. With the development of methods for producing hybrid seed corn in the late 20's, corn grain production reached levels undreamed of in the subsequent four decades. In the 60's, it became clear that relatively few corn breeding parents were being used to produce the bulk of American hybrid corn varieties. This narrowness of germ plasm set the stage for potential vulnerability to diseases, insects and other stresses.

1/ Public Law 89-106, 89th Congress, H.R. 5508, August 4, 1965 (Appendix 1)

In early 1970, environmental conditions in Southern and North-central corn producing regions were favorable for easy disease establishment and spread among vast plantings of highly uniform varieties. The SCLB epidemic became of national and international significance.

The P.L. 89-106 program provided a mechanism whereby appropriated funds could be used to selectively support research at those institutions having the necessary research expertise in their ongoing programs to meet this emergency. This Act made it possible for the Department, with the cooperation of the State Agriculture Experiment Stations and the corn seed industry to rapidly develop a coordinated, united research effort in finding a solution to a problem that, if uncontrolled, could wipe out the corn crop of the U.S.

Through this activity CSRS, in 1971 joined with experts in corn research in the other USDA research agencies, the Corn Seed Trade, and the administrators of various Land Grant Colleges and State Experiment Stations to evaluate Southern Corn Leaf Blight and its impact. This document (Appendix 1) set the stage for a Federal-State-Industry strategy to obtain emergency funding for research on this important epidemic of a major American crop. As a result of mutual efforts and agreement it was decided that CSRS, through its special grants program, would administer the funding of specific research in the State Agricultural Experiment Stations. Accompanying this activity, it was also agreed that the Agricultural Research Service of USDA would seek funds to conduct emergency programs within the federal research establishment. Research in the State Agricultural Experiment Stations was initiated in the late spring of 1971, culminating in grants to 15 different State Experiment Stations. Research efforts under this program continue in six states. Five projects continue with expected termination in June 1976, and one in June, 1977.

Historical Perspective

The farmer and corn breeder is confronted with new and changing corn disease problems. Within the last 15 years (since 1962) eleven new diseases have appeared in the U.S. In addition to southern leaf blight (Helminthosporium maydis Race T), these are yellow leaf blight (Phyllosticta maydis), eyespot (Kabatiella zeae), Helminthosporium leaf spot (H. carbonum), downy mildew (Sclerospora sorghi), anthracnose (Colletotrichum gramincolum), maize dwarf mosaic (MDM virus), maize chlorotic dwarf (MCD virus), leaf freckles and wilt (Corynebacterium nebraskensis), corn stunt (mycoplasma) and southern rust (Puccinia sorghi).

The Southern Corn Leaf Blight epidemic of 1970 is broadly recognized as a calamity that caused a greater damage and loss in a single crop within one year than any similar event in the history of agriculture 2/ The impacts of this disease will be discussed later. Future strategies to minimize the vulnerability of tommorrow's crops in view of today's concerns over the availability of food around the world are clearly of importance as we evaluate the corn blight phenomenon and the research directed specifically to it.

Background on Leaf Blight of Corn in the U.S.

Corn generally has been considered a rather healthy crop; however, it has been relatively susceptible to various fungus pathogens, to a small number of bacteria, nematodes and viruses, to a few mycoplasma - like agents and to a parasitic higher plant. Past outbreaks of corn diseases have stimulated searches for sources of genetically-controlled resistance. These sources of resistance have been incorporated into hybrid corn varieties of good agronomic quality. Past epidemics include those of Northern Corn Leaf Blight caused by Helminthosporium turcicum in 1939 to 1943, maize dwarf mosaic virus in the 1960's, corn stunt in the 1960's, and Stewart's wilt - a bacterial disease mainly on sweet corn. None of these diseases became sufficiently severe or widespread to have a marked effect on corn markets of the U.S. These diseases can be controlled or potentially controlled through genetic resistance.

In 1969 a disease of corn leaves and ears was observed in a few local areas in southern Iwoa, Illinois, and Indiana. During that season a relationship between male-sterile cytoplasm and susceptibility to this corn disease established.

It is important to elucidate the role of cytoplasmic male sterility in corn production, and thence its importance in the SCLB epidemic of 1970. When hybrid seed corn was first produced on a commerical scale over 35 years ago, fields in which such seed was produced were usually planted to several rows of the seed parent (female) and alternately, 1-2 rows of the pollen parent (male). Before pollen was shed by the tassels of female parent plants, the tassels were removed manually. Such detasseled plants would therefore be pollinated by pollen from the pollen parent plants. In this way, the desired cross in a given seed production field was assured and eliminated self-fertilization of seed parent plants.

Infrequently, a corn plant is found which produces no viable pollen. This condition is known as male sterility and presents clear advantages in plant breeding - it simplifies production through eliminating the need for detasseling. A male-sterile plant was found in Texas in 1944; sterility in this plant was controlled by still unknown factors present in the cell cytoplasm, not by genes contained in the nucleus. This source of sterility was designated Texas cytoplasm male sterility, (Tcms). It was transferred

2/ "A situation statement on the Southern Corn Leaf Blight", Feb. 26, 1971 (Appendix 2)

to many inbred corn lines by 6-8 cycles of backcrossing, with pollen of the inbred lines, and the offspring were all male-sterile. The farmer then bought seed that contained a blend of Tcms seed and normal-cytoplasm seed that produced plants bearing normal pollen.

Another widely used way of producing hybrid seed was by allowing Tcms plants in the seed-parent rows to be fertilized by pollen from the male parent plants that contain a nuclear genetic factor - a restorer gene known as Rf1 - which restored fertility to the progency of the male-sterile seed parent. All progency from such a male-female cross were all male-fertile and form normal pollen, thereby eliminating the need for the farmer to buy a blend as above, and hence insure a seed set.

Fertility restorers such as the Rf1 gene apparently have no effect on susceptibility of Tcms corn to Race T of H. maydis, thereby indicating that susceptibility is closely linked to Tcms cytoplasmic male sterility. Other sources of cytoplasmic male sterility have been isolated; some respond to Race T of the blight fungus as does Tcms, others totally different (i.e., resistant), and others with variations in reaction between high susceptibility and high resistance.

Adoption of the technology of cytoplasmic male sterility in corn production proceeded at a slow pace until the mid-fifties. Then the burgeoning needs for corn and the advances in other corn production technologies set in motion an acceleration in use of Tcms male sterility that amounted to about 85-90% of the hybrid seed corn production of the U.S. by 1970.

The SCLB Epidemic of 1970

During the corn production season of 1969, Tcms corn leaves and ears showed an atypical disease in a few localized areas in Iowa, Indiana and Illinois. The ears showed a grayish-black rot, and the morphology of the spores indicated that the fungus H. maydis was involved. Fields of normal cytoplasm plants showed very few leaf lesions and no ear infection. Plants in Tcms-seeded fields became severely infected between late August and late September of that year.

The pathogen was isolated that fall and winter, and inoculation of Tcms and normal cytoplasm corn seedlings in greenhouse studies clearly showed that the pathogen was a separate race of H. maydis. The old or common race of the fungus was again tested on normal cytoplasm and Tcms seedlings - both showing equal mild susceptibility - whereas the new race attacked Tcms seedlings vigorously while causing only mild infection of the normal cytoplasm seedlings. The new isolate was designated "Race T" and the common one, "Race O" that had been commonly recognized in many parts of the world for several years (1).

In January of 1970, it was clear that a leaf disease was causing severe damage on early-planted Tcms corn in Florida. Severe leaf lesions, decaying kernels in the infected ears and rotting stalks were observed. Soon afterward similar observations came in from southern Alabama and Mississippi with the same differential effects on Tcms and normal cytoplasm corn.

An unusually wet spring occurred in the southern corn producing states, and subsequent summer weather in the Corn Belt States was more humid and with higher-than-average rainfall--conditions highly favorable for rapid spore production of the fungus and ideal for rapid development of SCLB. Apparently the disease spread rapidly northward and westward out of the southeastern corn-producing states. The potential damage from this disease was not apparent as late as the end of July of 1970 when a majority of the corn in the Corn Belt was in full silk or even a week or two beyond this stage. By harvest time the disease was very severe in Ohio, Indiana, Iowa, Illinois, and parts of Maryland, Pennsylvania, New Jersey and Missouri. It was less damaging in Nebraska, Michigan, Minnesota, Wisconsin, southern Ontario Province of Canada and the New England States.

Many southern corn fields were a total loss, and some were plowed down and planted to other crops when crop failure became inevitable.

Fungicides were used in some states of the Corn Belt, but, in most cases, treatments were applied too late to be effective.

OBJECTIVE OF SCLB RESEARCH

Mission and Goals

Of the 11 USDA program missions, CSRS is identified with participation in three: 1), Rural Development; 2), Support for Non-Federal Governments and Institutions, and 3) Foreign Agricultural Development 3/. Of these, Mission Number 2 -- Support for Non-Federal Governments and Institutions -- is the framework under which the CSRS Special Grant activity on SCLB research is conducted.

Under this mission, "The USDA goal is to provide financial support for programs conducted through State and local governments and educational institutions so they can develop and bring to bear their special capabilities in strengthening the social and economic growth of both rural and urban America. Support for Non-Federal governments and institutions is the major Departmental mission implementing this Administration's goal of decentralizing Federal services and assistance. It is expected to be reorganized and strengthened following passage of the President's proposal on revenue sharing for Rural Development.

3/ "Agency Participation - USDA Program Missions"; "USDA Goal"; undated, (Appendix 3).

This mission has three operating goals:

-- Shared revenues (payments to States and countries where Non-taxable Forest Service Lands are located).

-- Grants to State Agricultural Experiment Stations and other institutions to support research.

-- Grants to support State, District of Columbia, and Puerto Rico Extension Services". (Appendix 3)

The CSRS Special Grants activity on SCLB research is conducted under the second operating goal above.

Technological Objectives

As will be seen later in this report, specific accomplishments from the subject grant research activity indicate areas that can be considered as sub-objectives of the overall program. However, the major objectives identified early in the planning and funding of the SCLB research program are listed in keeping with the historical perspective which those involved had in 1970 and 1971. They are:

1. Discover alternatives to, or improvements in male sterile cytoplasm.

2. Discover and develop new genotypes for resistance to Helminthosporium maydis, Race T.

3. Discover the mechanism of cellular response to Helminthosporium maydis, Race T.

COST OF RESEARCH PROGRAM

The CSRS Special Grant activity on SCLB research added significantly to the research base on corn leaf diseases existing in mid 1969 - early 1970. It is important to recognize that the concerned States, faced with continuing stresses for ongoing research programs and the ominous, unpredictable threat of SCLB, made major readjustments in personnel research priorities and major reallocations of the necessary funds for their support prior to substantive infusion of Federal funding to meet the emergency while faced with the need to maintain programs in other high priority research areas.

Prior to the recognition that a national emergency in agricultural production was developing in 1970, the SAES research efforts on corn leaf blights amounted to 5.7 SY and $226,678 in Federal and Non-Federal support. Upon recognition of the national (and international) scope of the epidemic, the concerned States redirected research thrusts in the amount of 15.3 SY (total effort 21.0 SY) and reallocated research funds (at the expense of other important research programs), in the amount of $622,166 (total effort: $848,844).

Important reallocations in the ARS research programs on SCLB were also made, resulting in a commitment of $539,100 to study of the disease. Therefore the Federal-State commitment to research on SCLB amounted to $1,387,944 prior to congressional appropriation of additional funds to accelerate vital research on the problem.

Following State, Federal and Industry testimony underlining the potential magnitude of the problem and its long-term implications, swift congressional action resulted in a supplemental appropriation of $1 million in the FY 1971 budget and an amendment to the FY 1972 budget appropriation $0.5 million for the CSRS Special Grants program for specific research on SCLB and related corn leaf diseases.

RESEARCH DISCOVERIES AND IMPLEMENTATION OF RESULTS

Research accomplishments are discussed according to the three previously - mentioned major objectives of the program.

Objective 1: Discover alternatives to, or improvements in male sterile cytoplasm.

Based on the earlier background relating SCLB susceptibility and presence of the Tcms component of corn hybrids, scientists and seed companies together rapidly accomplished the transition of hybrid seed corn production from one virtually totally based on the Tcms system as in 1970, to a 1971 seed supply consisting of approximately 25% Tcms, 25% normal cytoplasm hybrids, and 40% blends. The balance of seed for 1971 planting consisted of open-pollinated varieties and F_2 seed of hybrids harvested from production fields during 1970. By 1972, there was essentially no hybrid seed production using the Tcms system.

Therefore, by planting time in 1971 the above adjustments greatly reduced the threat of a 1971 SCLB epidemic. However, because of the unique involvement of the cytoplasm in this serious epidemic, and the additional cost of seed corn produced by the old normal cytoplasm-seed parent detasseling technology, it was imperative that the disease be studied thoroughly and that alternative pollen control systems be developed as soon as possible. Significant accomplishments during the rather short time interval following the 1970 epidemic are:

a. Alternate sources of cytoplasmic male sterility which are resistant to Race T and fungus Phyllosticta maydis have been collected, characterized, incorporated into parental inbreds and released to seed companies.

b. Another promising alternate system to control pollen involved the use of duplicate-deficiencies in conjunction with nuclear male sterile genes. This system has the advantage that diversity of cytoplasms can be employed. Seed stocks were released to commercial seed company breeders for potential development.

c. The successful development of a male gametocide to control pollen production would place no restriction on germplasm and free the corn breeder from the time delay and using resources to introduce any genetic system. A chemical, Dupont DPX 3778, shows some promise in preventing pollen shedding.

Objective 2: Discover and develop new genotypes for resistance to Helminthosporium maydis, Race T.

a. Reaction to disease depends upon the interaction of nuclear genes and cytoplasmic factors. Research has shown that the hyper-susceptibility of the Texas cytoplasm can be significantly reduced by the selection of higher levels of nuclear resistance. This has significant implications for other crops such as sorghum where cytoplasmic male sterility must be used to produce hybrid seed.

b. A genetically broad-based synthetic with normal cytoplasm has been developed that is highly resistant to "Race O". This synthetic could serve as a source from which more diverse parental inbreds resistant to SCLB could be drawn.

Objective 3: Discover the mechanism of cellular response to Helminthosporium maydis, Race T.

a. The toxin produced by H. maydis, Race T, is clearly capable of identifying Tcms cytoplasm. Attempts to purify this toxic principle suggest that it may consist of several components.

b. Work on the possible mechanism of the action of the toxin has progressed to the point that permits formulation of several working hypotheses which can be subjected to experimental verification. Among these are a vital role of toxin-induced chlorosis, a role for toxin in inducing losses of materials from cells needed for growth and sporulation of the pathogen, and an effect of toxin on cell permeability, (possibly one or more of the membrane systems), that may determine disease reaction.

c. The recognition that H. maydis Race T toxin is a unique and potent biologically active material that may be useful in investigation in plant physiology and other areas outside of plant pathology.

d. The toxin tests, although initiated prior to grant funding, were improved to do large-scale screening for Tcms cytoplasm both for the purpose of seed-lot testing and in breeding programs.

e. Practical application of the toxin test convinced seed producers of the value and need of cooperation with academia in the development of new and improved corn varieties.

BENEFIT FROM RESEARCH PROGRAM

Estimation of Losses from SCLB

To place magnitudes of benefits to various segments of U.S. agricultural economy in perspective, it is appropriate to discuss approximations of national losses in corn production potential regarding the 1970 corn crop following SCLB. The July 1, 1970 crop Report for corn 4/ amounted to 4.82 billion bushels. However, as corn harvest reports in the Corn Belt came in, the Department revised its crop estimates in the November 1 Report downward to 4.10 billion bushels 5/. The 700 million bushel decline was attributed mainly to SCLB. The season average price for corn in 1970 was $1.33 per bushel (2). Therefore, dollar losses in potential income amounted to $931 million in a crop valued at $5.51 billion in that year. In addition, the 1970 corn crop was 474 million bushels below 1969 production, for a $630 million drop in crop value 5/.

Estimation of Benefits from the CSRS SCLB Grants Research Program

During the first year of the CSRS Special Grants Program on Corn Blight scientists and research administrators agreed in the value of periodic workshops involving the grants recipients. The specificity of the area of research and the concerns of the participating scientists over close-knit communication and real-time assessments of progress and problems made this activity an ideal vehicle to incorporate a different dimension to the CSRS Special Grants Program. At the third annual conference on February 16-18, 1975, researchers reported on progress and deliberated in task groups to enumerate research discoveries and discuss implementation of results, (listed earlier under the three research objectives). They were also asked to consider cost-benefit values emerging from this research. Immediately, it became clear that these scientists were deeply concerned over science administration attempts to place numbers on benefits of complex research activity consisting of much fundamental science, particularly since new basic information was still emerging from the work.

Nevertheless, one task group at the conference, specializing on disease physiology and toxin tests, made the statement: "Although savings cannot be estimated precisely, the group believes that, in this area alone, they exceeded the value of total grants awarded."

4/ "Crop Production," July 1, 1970, Statistical Reporting Service; Crop Reporting Board, Cr Pr 2-2 (7-70), (Appendix 4).

5/ Ibid., Nov. 1, 1970, Cr Pr 2-2 (11-70), (Appendix 5).

It is possible to identify another component in savings. The Tcms sterile cytoplasm system for producing hybrid corn seed has been abandoned, returning to normal cytoplasm seed parent systems. The major impact of this has been the passing on of detasseling costs to the seed corn purchaser. It has been conservatively estimated that hybrid corn producers spend an average of $62 per acre for detasseling: It is assumed that about 22 million bushels of seed corn are produced annually. At an average yield of 50 bushels per acre of salable seed, then about 400,000 acres are planted to production. Therefore direct detasseling costs nationally are about $25 million, adding more than $1 to the price per bushel of seed corn 6/.

The chemical pollen gametocides and the alternate cytoplasm-nuclear genetic sterile systems being developed will eventually eliminate the detasseling cost. Changes in this technology are now occurring, but it is not possible to precisely predict rate or the time at which detasseling costs will be eliminated. It is generally agreed that the $25 million per year costs should be largely erased by 1978 - 1980.

It should be noted that the research base of $1,387,944 prior to the Congressional appropriation of $1.5 million under PL 89-106 in relation to the $931 million loss in potential crop value in 1970 and the $630 million potential crop value loss relative to 1969, give estimates of the potential cost/benefit ratio that existed in this area of research at the time the additional funding was being considered. It can be confidently assumed that if the States, the Federal government and industry had not acted promptly to solve this problem, the cost/benefit ratio would have continued to increase.

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6/ D. E. Alexander, Professor of Plant Genetics, University of Illinois, Personal Communication.

Publications

Another measure of the productivity of scientific research is the overall volume, scope and quality of published research reports. High-caliber publications began to emerge early in the life of the SCLB grants activity; they emerged at an impressive rate; and, there are strong indications that compelling new findings will continue for some unpredictable period into the future.

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APPENDIX

APPENDIX

1. Public Law 89-106; 89th Congress, H. R. 5508, Aug. 4, 1965

2. A Situation Statement on the Southern Corn Leaf Blight, Feb. 26, 1971

3. Agency Participation - USDA Program Missions, undated.

4. Crop Production, July 1, 1970, Statistical Reporting Service; Crop Reporting Board, Cr Pr 2-2 (7-70).

5. Ibid., November 1, 1970, Cr Pr 2-2(11-70).

APPENDIX I

Public Law 89-106
89th Congress, H. R. 5508
August 4, 1965

An Act

79 STAT. 431.

To facilitate the work of the Department of Agriculture, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, notwithstanding the provisions of existing law, except the Commodity Credit Corporation Charter Act and without regard to section 355, Revised Statutes, as amended (40 U.S.C. 255), but within the limitations of cost otherwise applicable, appropriations of the Department of Agriculture may be expended for the erection of buildings and other structures on land owned by States, counties, municipalities, or other political subdivisions, corporations, or individuals: *Provided*, That prior to such erection there is obtained the right to use the land for the estimated life of or need for the structure, including the right to remove any such structure within a reasonable time after the termination of the right to use the land: *Provided further*, That appropriations and funds available to the Department of Agriculture shall be available for expenses in connection with acquiring the right to use land for such purposes under long-term lease or other agreement.

Agriculture Department, administration.
Erection of buildings.
62 Stat. 1070.
15 USC 714 note.

SEC. 2. The Secretary of Agriculture is authorized to make grants, for periods not to exceed five years' duration, to State agricultural experiment stations, colleges, universities, and other research institutions and organizations and to Federal and private organizations and individuals for research to further the programs of the Department of Agriculture. Each recipient of assistance under this section shall keep such records as the Secretary shall prescribe, including records which fully disclose the amount and disposition by such recipient of the proceeds of such grants, the total cost of the project or undertaking in connection with which such funds are given or used, and the amount of that portion of the costs of the project or undertaking supplied by other sources, and such other records as will facilitate an effective audit. The Secretary of Agriculture and the Comptroller General of the United States or any of their duly authorized representatives shall have access for the purpose of audit and examination to any books, documents, papers, and records of the recipients that are pertinent to the grants received under this section.

Research grants.
Records.
Audit.

SEC. 3. The Secretary of Agriculture is authorized to obtain insurance to cover the liability of any employee of the Department of Agriculture for damage to or loss of property or personal injury or death caused by the act or omission of any such employee while acting within the scope of his office or employment and while operating a motor vehicle belonging to the United States in a foreign country.

Employee liability insurance.

SEC. 4. Section 602 of the Agricultural Act of 1954 (68 Stat. 908) is amended by adding at the end thereof the following:

"(e) Any officer or employee appointed and assigned to a post abroad pursuant to this title may, in the discretion of the Secretary of Agriculture, be assigned for duty in the continental United States, without regard to the civil service laws (and without reduction in grade if an appropriate position at the employee's grade is not available in any agency of the Department of Agriculture), for a period of not more than three years: *Provided*, That the total number of such employees assigned for duty in the continental United States under this provision shall not exceed fifteen at any one time: *Provided further*, That this Act shall not increase the number of persons employed at grade GS–16, GS–17, or GS–18."

Overseas personnel, assignment to U. S.
7 USC 1752.

79 STAT. 432.

Foreign currencies, release.
68 Stat. 456; 73 Stat. 606.

SEC. 5. Section 104(a) of the Agricultural Trade Development and Assistance Act of 1954, as amended (7 U.S.C. 1704), is further amended by inserting, after the word "*Provided*,", the following: "That the Secretary of Agriculture may release such amounts of the foreign currencies so set aside as he determines not to be needed, within a reasonable period of time, for such purpose: *Provided further*,".

Employees on loan to states; health benefits.

SEC. 6. Section 4 of the Act of August 2, 1956 (ch. 878, 70 Stat. 934; 7 U.S.C. 1884), is hereby amended—

(1) by striking the word "insurance" and substituting the word "benefits";

(2) by inserting after "Federal Employees' Group Life Insurance Act of 1954" the words "and the Federal Employees Health Benefits Act of 1959,"; and

68 Stat. 736.
5 USC 2091 note.
73 Stat. 709.
5 USC 3001 note.

(3) by inserting after "employees' life insurance fund" the words "or the employees' health benefits fund, as the case may be,".

Working capital fund.
57 Stat. 393.

SEC. 7. Section 1 of the Act of July 12, 1943 (7 U.S.C. 512-1), is hereby amended by striking out the word "reimbursed" and inserting in lieu thereof the words "credited with advances or reimbursements" and inserting after the word "*Provided*," the following: "That such advances shall not be available for any period beyond that provided by the Act appropriating the funds: *Provided further*,".

Transfer of funds.

SEC. 8. Subject to limitations applicable with respect to each appropriation concerned, each appropriation available to the Department of Agriculture may be charged, at any time during a fiscal year, for the benefit of any other appropriation available to the Department, for the purpose of financing the procurement of materials and services, or financing activities or other costs, for which funds are available both in the financing appropriation so charged and in the appropriation so benefited; except that such expenses so financed shall be charged on a final basis, as of a date not later than the close of such fiscal year, to the appropriations so benefited, with appropriate credit to the financing appropriation.

Repeal.
54 Stat. 1019.

SEC. 9. Section 8f of the Agricultural Adjustment Act of 1938, as amended (7 U.S.C. 608f), is hereby repealed.

Approved August 4, 1965.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 306 (Comm. on Agriculture).
SENATE REPORT No. 505 (Comm. on Agriculture & Forestry).
CONGRESSIONAL RECORD, Vol. 111 (1965):
Apr. 5: Considered and passed House.
July 23: Considered and passed Senate.

GPO 50-139

A SITUATION STATEMENT ON THE SOUTHERN CORN LEAF BLIGHT[1]

The outbreak of Southern Corn Leaf Blight (SCLB) in the United States during 1970 caused a greater production loss on a single crop in one year than any similar event in the history of agriculture. Although this disease, caused by the fungus Helminthosporium maydis, has been known in the U. S. since 1925, it caused losses of only local importance until 1969 because many of our corn varieties are resistant to the common form (Race O) of this fungus. The catastrophic outbreak in 1970 was due to the widespread occurrence of a new biotype of the SCLB fungus which has been designated Race T. Furthermore, it has been shown that Race T is highly specific to and destructive on corn hybrids which carry the Texas source of male-sterile cytoplasm (Tms). In 1970, the Tms cytoplasm was used in about 90% of our corn hybrids as a means of reducing production costs for hybrid seed corn.

The new Race T was first identified from infected corn plants collected in central Illinois in September, 1969. Although causing serious local damage, the consequences for 1970 were not predictable at that time. Race T was identified in Florida in the spring of 1970 causing losses of epidemic proportions and subsequently spread northward at an alarming rate. By the end of the 1970 growing season, SCLB had spread across the commercial corn production areas of the southern, northeastern and northcentral states. In all areas, the association between heavy disease losses, Race T, and the Tms cytoplasm was observed.

1/ Initial draft by: G. F. Sprague (USDA-ARS), J. L. Apple (North Carolina AES), C. R. Jackson (Georgia AES), A. L. Hooker (Illinois AES), and J. M. Barnes (USDA-CSRS). 11 February 1971.

Revised and supplemented by J. L. Apple (North Carolina AES) using economic data assembled by T. E. Nichols (North Carolina Agricultural Extension Service). 26 February 1971.

Many individuals quickly expressed the opinion that the SCLB problem will be solved by shifting from the Tms cytoplasm to another male-sterile cytoplasm with SCLB resistance or to normal (N) cytoplasmic types. Undoubtedly, these shifts will be of great value in reducing the intensity of the disease in the short run, but mounting evidence indicates that other potentially destructive new biotypes or races are already present. Given the economic importance of the U. S. corn crop, the stakes are too high and the risks too great to gamble on the future course of the SCLB disease. The situation demands immediate attention.

Prospects for the Future

Much speculation has been voiced and written about the 1971 corn crop in view of the uncertainties of the SCLB problem and the short supply of N-cytoplasm type hybrid corn. It is estimated that about 25% of the national acreage could be planted to N-cytoplasmic types, 35% to blends of N- and Tms-cytoplasmic types and 40% to Tms-cytoplasmic types. At this time, however, it is not known what the planting pattern will be for the 1971 crop. Given the scarcity of N-cytoplasmic types and the relatively high prices for seed corn, some farmers may be prompted to plant F_2 seeds from a double cross F_1 hybrid. Experimental results indicate that this practice will be accompanied by a 15-50% reduction in yield as compared to the corresponding F_1 generation, depending upon the hybrid combination involved, location and growing conditions.

In addition to the uncertainties as to the type of seed corn the farmer can and will plant in 1971, the severity of the SCLB problem in 1971 is also highly unpredictable. Some have considered that the epidemic of 1970 was attributable in large part to atypical climatic conditions and rationalize that these conditions are not likely to be duplicated in 1971. Although no comprehensive comparative analysis is available, preliminary studies indicate that climatic

[illegible] quickly depressed the [illegible]

[illegible] affecting [illegible] the [illegible]

[illegible] absence or [illegible] (b) extended [illegible]

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[illegible] of rate [illegible]

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[illegible]

N-cytoplasm [illegible]

[illegible] types [illegible]

[illegible] will [illegible] for the 1971 crop. Given [illegible]

the relatively big prices for seed corn, [illegible]

[illegible] from a double cross F[illegible] hybrid. [illegible]

[illegible] will be accompanied by a 15-50% reduction [illegible] yield [illegible]

[illegible] depending upon the hybrid [illegible]

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[illegible] the uncert[illegible] as to the type of seed corn the farmer [illegible]

[illegible] the severity of the SCLB problem in 1971 is a [illegible]

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[illegible] effects.

conditions in 1970 were not unusual when considered across the regions in which SCLB reached epidemic proportions. Observing the manner in which the disease epidemic apparently swept across the South and northward to Minnesota during a single growing season, one can rationalize that the SCLB fungus can infect corn and produce spores under a wide range of environmental conditions. This indicates that (1) the environmental conditions (especially temperature, humidity and rainfall) favoring development of a SCLB epidemic occur frequently during a "normal growing season" throughout the corn-producing areas of the U. S. and (2) the environmental conditions in 1971 are not likely to differ so greatly from 1970 as to retard significantly the progress of the disease. Another factor which will have a profound effect on the intensity of SCLB in 1971 is the amount of inoculum (number of viable spores) which overwinters to produce infection this spring. It is probable that the overwintering inoculum level will be higher than in any previous year, and this could produce an epidemic earlier in the growing season than in 1970 with correspondingly greater reductions in yields.

It is now well documented that hybrids with Tms cytoplasm are highly susceptible to the new Race T of the fungus, and it is generally assumed that N-cytoplasmic types are resistant not only to Race T but to the common Race O and all other types of the SCLB fungus. Preliminary research indicates the existence of other more highly destructive biotypes of H. maydis which can cause serious damage even to N-cytoplasmic types. Although the supporting evidence is far from conclusive on this point, this aspect of the problem must be monitored very carefully in 1971 and succeeding years.

In developing hybrid types with SCLB resistance for planting after 1971, we now recognize several complicating factors. The economic feasibility of commercial hybrid seed corn production in the U. S. is contingent upon the availability of [illegible]

the female parents in producing single- and double-cross hybrids. Consequently, shifting to N-type cytoplasm definitely is not the solution over the long term! Alternative sources of male-sterile cytoplasms are available; viz., sources "C" and "S". It is disturbing to note, however, that new races of the fungus have been identified under greenhouse testing conditions that severely blight hybrids carrying these sources of male sterility. Although these observations have been made under greenhouse conditions, the evidence strongly suggests that the same races or biotypes of the fungus can evolve and become established under field conditions if these alternative sources of male-sterile cytoplasm are placed in widespread use.

Although much additional evidence is needed, current information definitely supports the possibility that the SCLB problem is much more complex than initially suspected. The situation supports the case for careful research into this and similar problems that place in jeopardy the future supply of such an important commodity.

Economic Analysis

Most of the corn grown in the United States is used for feeding farm animals. During the past five years, 1965-1969, about 80% of the corn produced was fed to livestock, 13% was exported, and 7% was used for industrial purposes, seed and human food. In recent years the corn crop is divided among animals on feed in these proportions - poultry, 22 percent; hogs, 45 percent; dairy, 18 percent; beef, 13 percent; and other, 2 percent.

With corn supplies down some 10%, the 1970 crop of 4.1 billion bushels will be substantially below market requirements, so that a sizable part of the carry-over supply must be used. The USDA estimates a usage level of 4.4-4.5 billion bushels during the current marketing year, based on a 3% reduction in domestic feed usage compared with last year due to higher feed prices, lighter marketing

weights and increased utilization of other grains (Table 1). There are 13% more hogs and 2-3% more cattle on feed than a year ago.

Exports may be down from last year as much as 15% because of higher corn prices and competition from other grains. Japan will import corn from Thailand and Africa in addition to diverting some 1.4 million metric tons of rice from food to feed uses. European markets are turning to the Southern Hemisphere countries of Argentina and Brazil for some of their requirements. Such reductions would hold total disappearance this year to 4,435 million bushels, about 6% below a year ago, but it would leave only 676 million bushels for carryover in the fall, the smallest since 1952 (Table 2).

If sufficient corn and other feed grains are not produced in 1971 to meet potential demand in the 1971-72 marketing year, carryover stocks would slip to the lowest level of many years. The rise in market prices would then ration the use of these crops with adverse effects on the export business and dire consequences for livestock producers and U. S. consumers.

If farmers carry out planting intentions tallied by a special USDA survey on 1 January 1971, corn acreage will be up 6% from a year ago. A national crop of 4.4 billion bushels, 6.9% above 1970, would result from the acreage if crop conditions were no worse than a year ago and if yields averaged 72 bushels per acre, the same as last year. But given the uncertainties of availability of SCLB-resistant seed for planting and severity of the SCLB attack in 1971, the size of the 1971 harvest is still a big question; consequently, three production possibilities are likely with this acreage:

(1) At its worst, the blight in 1971 could reduce the national crop to 3.7 billion bushels. With a crop this small the result would be a loss of feed grain exports, liquidation of livestock followed later by increased meat imports.

(2) An output of 4.8 billion bushels would occur with average or so weather and light blight. The result would be a continued steady supply of livestock products, a reasonable amount of corn for export, and some needed rebuilding of carryover.

(3) Favorable weather and minimal blight could produce a crop as great as 5.2 billion bushels. This would result in low prices, heavy CCC take over and overstimulation of livestock production.

A national crop of 4.4 billion bushels in 1971 would place the price of No. 2 corn at harvest at $1.40-$1.45/bushel in the Corn Belt states and $1.50-$1.55 in the South and Southeast. If a crop of only 3.7 billion bushels materializes, the price could be as high as $1.75 and $1.85 respectively in these regions which could cause significant retail price increases for animal products.

Current Research

Much of the current research on SCLB is supported by reallocated resources which have been diverted from other priority problem areas within the State Agricultural Experiment Stations and the U. S. Department of Agriculture. The majority of this research was begun as recently as May, 1970 in response to the corn blight emergency; therefore, limited progress has been made. Since much of the present research represents an emergency response, it is likely to be discontinued short of meaningful answers unless additional resources are committed to this research area.

Research is being conducted by 23 State Agricultural Experiment Stations and several agencies of the U. S. Department of Agriculture. Much attention is being given to overwintering of the fungus, to the susceptibility of commercial varieties and breeding lines, and to the factors influencing infection and disease development. Most of the continuing projects on corn genetics and breeding are giving

attention to the development of SCLB resistance. Possibilities of disease control by cultural methods and by the use of fungicides are being studied. The effects of the disease on seed quality and the drying, storage, and milling characteristics of infected grain are being investigated.

Computerized disease forecasting and a disease warning service, based on the contributions of numerous observers throughout the country, are being readied for use in 1971. Toxicity of SCLB infected plant parts to warm-blooded animals, particularly cattle, swine, and poultry, has been studied during the past crop season. No short-term toxicity has been found.

Although the emergency response to this serious disease problem has been substantial in terms of aggregate effort, much of this research has been superficial and was conceived primarily to answer immediate questions posed by producers, the seed trade, processors, and the livestock industry. In contrast to the current effort, this problem demands a better coordinated and more comprehensive multidisciplinary effort to provide information basic to a more stable corn production system.

High Priority Research Needs

Since the new Race T of H. maydis possesses different infectivity characteristics, past research on this disease has limited current relevance. A number of problems require solution, and concerted research efforts by the State Experiment Stations, USDA, the Hybrid Seed industry, and other interest groups will be required. A coordinated State-Federal Task Force has been established to review current research and to establish new research priorities. Research activity must be both multidisciplinary and regional to cope with the diversity of problems, the different maturities of hybrids, and the widely differing climatic conditions under which corn is grown. Some of the high priority research needs are given below.

1. Search for new sources of resistance

Susceptibility to leaf blights is influenced by both cytoplasmic and genetic components. Hybrids with N cytoplasm tend to be more resistant than hybrids with Tms cytoplasm to Race T of the fungus. These differences are not absolute and a shift to N cytoplasm hybrids (detasseling) does not provide an adequate solution to the leaf blight problem. Consequently, screening of local and exotic types must be undertaken to find more adequate levels of resistance. The role of genic and cytoplasmic differences, their modes of action and interaction must be clarified.

2. Genetic variability of the pathogen

New races of plant pathogens may occur at any time through mutation and genetic recombination. Race T of SCLB illustrates this possibility. Laboratory studies indicate additional new races of this fungus exist. Whether these will become destructive under field conditions cannot be predicted with any accuracy. Greater knowledge concerning disease production potential is required as a possible safeguard against outbreaks of new forms and as a general guide for breeding and genetic studies on the development of new, more highly resistant corn and sorghum.

3. Epidemiology

Factors which contribute to the development of an epidemic of SCLB are not thoroughly understood. How important is over-wintering as opposed to wind-blown inoculum from the South? Is seed transmission an important factor in disease spread? What are the temperature and moisture conditions required for

[illegible] cytoplasmic [illegible]

tend to a more [illegible] the [illegible]

Race T of [illegible]

[illegible] shift [illegible]

[illegible]

New races of [illegible]

mutation and genetic recombination [illegible]

it a possibility [illegible]

rate of this fungus exist. When [illegible]

field conditions would [illegible]

water knowledge concerning [illegible]

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useful guide for breeding and [illegible]

of new, more highly [illegible]

[illegible] development of [illegible]

How important [illegible]

[illegible] from the South [illegible]

factor in disease [illegible]

infection? What environmental or internal factors influence the length of the infection cycle and the quantities of spores produced? Answers to these and many other questions must be sought if effective control measures are to be evolved.

4. Chemical control

None of the currently used seed-treatment chemicals provide adequate protection against seed-borne infection. Extensive screening of new materials must be undertaken. Two chemicals, Maneb and Zineb, are currently cleared for use on corn. These are protectants only and repeated spray applications are required. Under conditions of early infection, the use of these chemicals may not be economic. A search must be made for systemics which provide greater and more lasting protection against infection.

5. Mammalian toxicity

Short-term trials with cattle, swine, poultry, and laboratory animals have shown no toxic effects from feeding stover or grain from blighted plants. Information is not available on possible chronic effects, particularly with pregnant animals. The possibility of chronic toxicity should be explored even though such research would be expensive.

6. Development of new disease control strategies

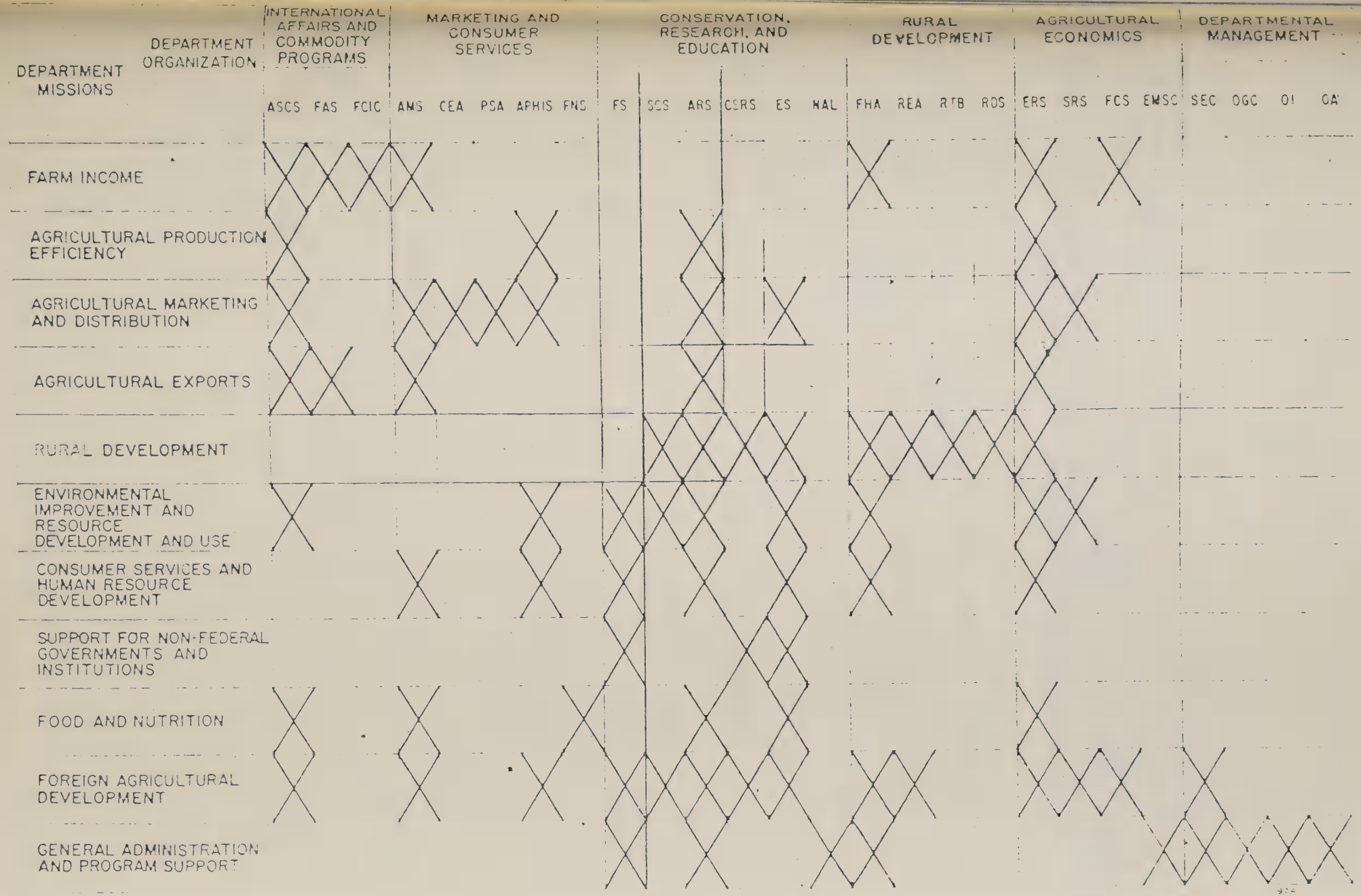
The SCLB epidemic of 1970 demonstrates dramatically the need for carefully planned disease control strategies for each of the major food and fiber crops basic to the Nation's agricultural economy. This must be a well coordinated effort involving State and Federal agencies as well as agri-business. Integrated pest management systems must be developed which are practical, theoretically sound and protective of environmental quality.

Table 1. Corn supplies and utilizations, annual 1961-1970

Crop year	Corn usage	Free supply	Government supply	Total supply
		(million bushels)		
1961	3,962	3,725	1,890	5,615
1962	3,895	3,725	1,535	5,260
1963	3,848	4,110	1,275	5,385
1964	3,875	3,721	1,300	5,021
1965	4,392	4,308	924	5,232
1966	4,135	4,521	437	4,958
1967	4,422	5,210	374	5,584
1968	4,443	4,842	714	5,556
1969	4,698	4,961	736	5,697
1970	4,435	4,511	600	5,111

Table 2. Corn: Supplies and utilization, United States, average 1963-67, annual 1965-69, estimated 1970

Marketing year beginning	Supply				Utilization				
					Domestic use				
	Carryover	Production	Imports	Total	Feed	Food, industry and seed	Total domestic	Exports	Total use
	(million bushels)								
Average 1963-67	1,142	4,093	1	5,236	3,203	355	3,558	576	4,134
1965	1,147	4,084	1	5,232	3,347	358	3,705	687	4,392
1966	840	4,117	1	4,958	3,284	364	3,648	487	4,135
1967	823	4,760	1	5,584	3,421	367	3,788	634	4,422
1968	1,162	4,393	1	5,556	3,521	386	3,907	536	4,443
1969	1,113	4,583	1	5,697	3,688	394	4,082	616	4,698
1970 E	999	4,110	2	5,111	3,550	395	3,945	490	4,435


DEPARTMENT ORGANIZATION
DEPARTMENT MISSIONS
INTERNATIONAL AFFAIRS AND COMMODITY PROGRAMS
MARKETING AND CONSUMER SERVICES
CONSERVATION, RESEARCH, AND EDUCATION
RURAL DEVELOPMENT
AGRICULTURAL ECONOMICS
DEPARTMENTAL MANAGEMENT
ASCS FAS FCIC AMS CEA PSA APHIS FNS FS SCS ARS CSRS ES NAL FHA REA RTB RDS ERS SRS FCS EMSC SEC OGC OI OA
FARM INCOME
AGRICULTURAL PRODUCTION EFFICIENCY
AGRICULTURAL MARKETING AND DISTRIBUTION
AGRICULTURAL EXPORTS
RURAL DEVELOPMENT
ENVIRONMENTAL IMPROVEMENT AND RESOURCE DEVELOPMENT AND USE
CONSUMER SERVICES AND HUMAN RESOURCE DEVELOPMENT
SUPPORT FOR NON-FEDERAL GOVERNMENTS AND INSTITUTIONS
FOOD AND NUTRITION
FOREIGN AGRICULTURAL DEVELOPMENT
GENERAL ADMINISTRATION AND PROGRAM SUPPORT

SUPPORT FOR NON-FEDERAL GOVERNMENTS AND INSTITUTIONS MISSION

USDA Goal

The USDA goal is to provide financial support for programs conducted through State and local governments and educational institutions so they can develop and bring to bear their special capabilities in strengthening the social and economic growth of both rural and urban America. Support for non-Federal governments and institutions is the major Departmental mission implementing this Administration's goal of decentralizing Federal services and assistance. It is expected to be reorganized and strengthened following passage of the President's proposal on revenue sharing for Rural Development.

This mission has three operating goals:

-- Shared revenues (payments to States and counties where non-taxable Forest Service lands are located).

-- Grants to State Agricultural Experiment Stations and other institutions to support research.

-- Grants to support State, District of Columbia, and Puerto Rico Extension Services.

[illegible]

[illegible] production [illegible] 1,320 million bushels, [illegible] (2 [illegible] bushels) above last year, and 10 percent (147 million bushels) [illegible] 1968. Prospective yield is 83.1 bushels per acre; in 1969, it was 83.9 bushels.

Winter Wheat production at 1,094 million bushels is 2 percent (19 million bushels) above a month earlier because yields exceeded earlier expectations in the Great Plains and the Pacific Northwest. This forecast is 5 percent (53 million bushels) below last year's production and 11 percent below 1968.

Other Spring Wheat is forecast at 204 million bushels, 0.3 percent (0.6 million bushels) less than last year and 15 percent (37 million bushels) less than in 1968.

Durum Wheat at 59 million bushels is 93 percent (55 million bushels) below the 1969 crop and 50 percent (49 million bushels) below 1968. Acreage for harvest is 40 percent below last year and yield per acre prospects are also down.

Oat production is forecast at 930 million bushels, up 1 percent (7.7 million bushels) from 1969 and 2 percent (18.3 million bushels) [illegible]

Soybean acreage for beans at 41.6 million is 2 percent (762,000 acres) more than last year, and 1 percent (315,000 acres) more than the [illegible]

Sorghum acreage for harvest at 17.1 million is 0.4 percent (68,000 acres) above last year, but 2 percent (405 thousand acres) less [illegible]

Late Summer Potato crop at 29.3 million cwt. is 1 percent (171,000 cwt.) more than last year, but 2 percent (623,000 cwt.) below 1968.

Fall [illegible] acreage for harvest at 1.1 million acres is 3 percent (37 thousand acres) above 1969, and 7 percent (77 thousand acres) [illegible]

Apple production from commercial orchards is forecast at 6.5 [illegible] pounds, 4 percent below last year but 19 percent above the [illegible]

Grape production is forecast at 3.8 million tons, 10 percent below [illegible] and 11 percent below 1968.

[illegible]

[illegible]

Crop Pr. 2-3 (9-70)

Corn, grain	bu.								
Wheat, all	"								
Winter	"								
Durum	"								
Other spring	"								
Oats	"								
Barley	"								
Rye	"								
Flaxseed	"								
Rice	cwt.								
Hay, all	ton								
Hay, wild	"								
Hay, alfalfa	"								
Hay, clover and timothy 3/	"								
Hay, lespedeza	"								
Beans, dry edible (Cleaned)	cwt.								
Peas, dry field	"								
Potatoes	cwt.								
Winter	"								
Early spring	"								
Late spring	"								
Early summer	"								
Late summer	"								
Fall	"								
Total	"								
Sweetpotatoes	"								
Tobacco	lb.								
Sugarcane for sugar and seed	ton								
Sugarbeets	"								
Peanuts	lb.								

1/ Does not include [illegible]

2/ Lewis.

3/ Includes [illegible]

4/ Plant cotton will be [illegible] July 11, 1940.

5/ Condition July 1.

Release:
November 10, [illegible]
3:00 P.M. [illegible]

HIGHLIGHTS OF U.S. CROP REPORT AS OF NOVEMBER 1, 1970

Corn for grain is forecast at 4,104 million bushels, 2 percent (84 million bushels) below the October 1 forecast and 15 percent (716 million bushels) below July 1 this year. This is 10 percent (474 million bushels) below 1969 and 7 percent (289 million bushels) less than in 1968.

Soybean production, forecast at 1,134 million bushels, is 0.4 million bushels below last month. The forecast is 2 percent (17.3 million bushels) more than 1969 and 3 percent above 1968.

Sorghum grain prospects, at 703 million bushels, are up 1 percent (6.0 million) from last month but 5 percent (35.3 million bushels) below 1969 and 4 percent below the 1968 crop.

Apple production (commercial) is estimated at 6.3 billion pounds, 6 percent (0.4 billion pounds) less than 1969 but 16 percent (0.9 billion pounds) above 1968.

Pecan production of 152.5 million pounds is down 32 percent (72.6 million pounds) from last year and 21 percent (40.0 million pounds) from 1968.

Orange production (excluding California Valencias) is expected to total 193 million boxes, 15 percent (25.1 million boxes) above last year and 22 percent (34.8 million boxes) more than two years earlier. (October 1 forecast for Florida carried forward.)

Fall Potato production of 252 million cwt. is 1 percent more than the October 1 forecast and 6 percent above 1969 crop.

Cranberries are estimated at 2.1 million barrels, 13 percent (0.4 million barrels) more than 1969 and 40 percent (0.6 million barrels) above 1968.

UNITED STATES DEPARTMENT OF AGRICULTURE
Statistical Reporting Service
CrCr 2-3 (11-70)

					1953	1954		
						1,377,[illegible]	4,182,[illegible]	
	"	[illegible]	[illegible]	[illegible]	[illegible]	1,35[illegible],042	1,[illegible],[illegible]	[illegible]
	"	[illegible]	[illegible]	[illegible]	1,[illegible]	1,137,[illegible]	1,19[illegible],[illegible]	[illegible]
	"	[illegible]	[illegible]	[illegible]	[illegible]	10[illegible],[illegible]	[illegible],[illegible]	
	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible],[illegible]	[illegible],[illegible]	
[illegible]	"	78.1	[illegible]	[illegible]	[illegible]	949,974	881,[illegible]	[illegible]
[illegible]	"	93.6	84.6	87.5	[illegible]	417,156	410,285	[illegible]
[illegible]	"	[illegible]	41.4	41.7	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	"	[illegible]	24.5	23.3	[illegible]	31,[illegible]	36,186	[illegible]
[illegible]	"	12.9	13.5	10.2	[illegible]	36,413	30,[illegible]	[illegible]
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]	91,383	84,980	[illegible]
[illegible]	cwt.	2/[illegible]	2/1,[illegible]	2/[illegible]	[illegible]	743,124	701,[illegible]	[illegible]
[illegible]	lb.	[illegible]	58.2	61.3	[illegible]	10,[illegible]	20,[illegible]	[illegible]
[illegible]	bale	2/[illegible]	[illegible]	2/142	[illegible]	127,127	126,[illegible]	[illegible]
[illegible]	cent	[illegible]	[illegible]	2.02	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	"	.89	.88	.88	[illegible]	[illegible]	[illegible]	[illegible]
[illegible], [illegible]	"	2.71	2.81	2.75	[illegible]	74,[illegible]	75,[illegible]	[illegible]
[illegible], [illegible] and	"	1.77	1.79	1.73	[illegible]	23,[illegible]	23,[illegible]	[illegible]
[illegible] 4/	"	1.40	1.42	1.45	2,[illegible]	2,101	2,[illegible]	[illegible]
[illegible], [illegible]								
[illegible], dry [illegible]								
([illegible])	cwt.	2/1,[illegible]	2/1,[illegible]	2/1,[illegible]	17,[illegible]	18,[illegible]	[illegible]	[illegible]
	"	2/1,[illegible]	2/1,[illegible]	2/1,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Peas, dry field	bu.	[illegible]	27.3	27.3	1,[illegible]	1,[illegible]	1,[illegible]	[illegible]
Soybeans for beans	bu.	1,[illegible]	1,[illegible]	2,[illegible]	[illegible]	2,[illegible]	2,[illegible]	[illegible]
Peanuts 5/								
Potatoes:								
Winter	cwt.	177	183	184	[illegible]	[illegible]	[illegible]	[illegible]
Early spring	"	[illegible]	175	162	[illegible]	[illegible]	[illegible]	[illegible]
Late spring	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Early summer	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Late summer	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fall	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	"	[illegible]	221	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sugarcane for [illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tobacco	lb.	1,[illegible]	1,[illegible]	[illegible]	1,[illegible]	1,[illegible]	1,[illegible]	[illegible]
Sugarcane for sugar								
and [illegible]	cent	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sugar beets	"	[illegible]	[illegible]	[illegible]	17	17	[illegible]	[illegible]
Sugar [illegible]	lb.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Hops	lb.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Flaxseed	bu.	[illegible]	2/[illegible]	2/[illegible]	---	---	---	---

1/ Do not include Alaska and Hawaii, except for sugarcane.

2/ Estimates for wheat, oats, barley, rye, flaxseed, hay, dry field peas, early spring, late spring, early summer, late summer potatoes, tobacco, and hops are not based on current intentions, but are based on [illegible] and from previous reports.

3/ Bushels.

4/ Excludes [illegible] potatoes and [illegible] hay.

5/ Harvested for nuts.

6/ [illegible] November 1.